IN THE CLAIMS

1. (Withdrawn) A method for constructing a database having digital video data information representing a plurality of video sequence, each video sequence having a set of image frames of the digital video data, the method comprising the steps of:

a) partitioning each image frame of each video sequence into L number of sub images, wherein each sub-image is further partitioned into S x T number of image-blocks, L, S and T being positive integers;

b) assigning one of 5 number of reference edges to each image-block to thereby generate L number of edge histograms for each image frame, wherein the edge histograms include the M edge histogram bins and the reference edges include 4 number of directional edges and a non-directional edge;

c) normalizing the edge histogram bins contained in each edge histogram by S x T to thereby generate M number of normalized edge histogram bins for said each image frame;

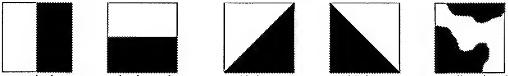
d) calculating M representative edge histogram bins of said each video sequence in order to generate L number of representative edge histograms of each video sequence based on the normalized edge histogram bins of said each image frames; and

e) non-linearly quantizing the representative edge histogram bins to generate M number of quantization index values as a second image descriptor for said each representative edge histogram to be stored in the database.

2. (Withdrawn) The method as recited in claim 1, wherein the directional edges includes a vertical edge, a horizontal edge, a 45 degree edge, a 135 degree edge and the non-directional edge represents an edge of undesignated direction except for the 4 directional edges.

3. (Withdrawn) The method as recited in claim 2, wherein the vertical edge, the horizontal edge, the 45 degree edge, the

135 degree edge and the non-directional edge are, respectively, expressed as:



vertical edge | horizontal edge | 45 degree edge | 135 degree edge | non-directional edge

4. (Withdrawn) The method as recited in claim 3, wherein the step a) includes the steps of:

a-1) dividing said each image frame into N × N non-overlapping sub-images to thereby form L number of rectangle-shaped sub-images, N being a positive integer; and

a-2) dividing the sub-image into S × T non-overlapping blocks to thereby form S × T number of square-shaped image-blocks.

5. (Withdrawn) The method as recited in claim 4, wherein the step b) includes the steps of:

b-1) assigning one of the reference edges to each image block; and

b-2) counting the number of each reference edge included in each sub-image to generate the L number of the edge histograms for the each image frame.

6. (Withdrawn) The method as recited in claim 5, wherein the step b-1) includes the steps of:

b-11) dividing each image-block into 2 × 2 sub-blocks;

b-12) assigning a corresponding filter coefficient to each sub-block;

b-13) calculating a set of 5 edge magnitudes corresponding to five edges for each image-block by using the filter coefficient; and

b-14) expressing the image-block as an edge having a maximum edge magnitude by comparing the calculated edge magnitudes each other.

7. (Withdrawn) The method as recited in claim 6, wherein the 5 edge magnitude are obtained by using 5 number of equations, which are expressed as:

$$m_v(i,j) = \left| \mathop{!}_{k=0}^{3} a_k(i,j)\ \ f_v(k) \right|;$$

$$m_h(i,j) = \left| \mathop{!}_{k=0}^{3} a_k(i,j)\ \ f_h(k) \right|;$$

$$m_{d!45}(i,j) = \left| \mathop{}_{k=0}^{3} a_k(i,j) \# f_{d!45}(k) \right|;$$

$$m_{d!135}(i,j) = \left| \mathop{}_{k=0}^{3} a_k(i,j) \# f_{d!135}(k) \right|; \text{ and}$$

$$m_{nd}(i,j) = \left| \mathop{!}_{k=0}^{3} a_k(i,j)\ \ f_{nd}(k) \right|,$$ where $m_v(i,j)$, $m_h(i,j)$, $m_{d!45}(i,j)$, $m_{d!135}(i,j)$ and $m_{nd}(i,j)$, respectively, denote vertical, horizontal, 45 degree, 135 degree and non-directional edge magnitudes for a $(i,j)^{th}$ image-block; $a_k(i,j)$ denotes an average gray level for a sub-block assigned k in the $(i,j)^{th}$ image-block and $f_v(k)$, $f_h(k)$, $f_{d!45}(k)$, $f_{d!135}(k)$ and $f_{nd}(k)$ denote, respectively, filter coefficients for the vertical, horizontal, 45 degree, 135 degree and non-directional edges where k represents a number assigned to each sub-block.

8. (Withdrawn) The method as recited in claim 6, wherein the maximum edge magnitude is greater than a predetermined threshold value, otherwise the image block is considered to contain no edge.

9. (Withdrawn) The method as recited in claim 1, wherein the representative edge histogram bins are calculated based on a mean value of corresponding edge histogram bins of image frames of the video sequence.

10. (Withdrawn) The method as recited in claim 1, wherein the step e) includes the step of e1) non-linearly quantizing each of the representative edge histogram bins by using a corresponding non-linear quantization table, wherein the step

e1) is provided with 5 number of non-linear quantization tables, each corresponding to said each reference edge.

11. (Withdrawn) The method as recited in claim 10, wherein the step e1) includes the steps of:

e2-1) mapping each of the representative edge histogram bins into a representative value contained in each corresponding reference edge quantization table; and

e2-2) generating 3 bits of a quantization index value representing the representative value for said each representative edge histogram bin to thereby generate L x 5 number of the quantization index values as the second image descriptor for the video sequence.

12. (Withdrawn) The method as recited in claim 10, wherein the normalized edge histogram bins are non-linearly quantized by using a non-linear quantizer that is designed based on a Lloyd-Max algorithm.

13. (Withdrawn) The method as recited in claim 5, wherein said N is 4.

14. (Withdrawn) The method as recited in claim 12, wherein the quantization table includes a table for a vertical edge histogram bin representing the number of vertical edges in the sub-image, which is expressed as:

Index	Range	Representative value
0	0.0000000 ~ 0.0343910	0.010867
1	0.0343910 ~ 0.0787205	0.057915
2	0.0787205 ~ 0.1221875	0.099526
3	0.1221875 ~ 0.1702110	0.144849
4	0.1702110 ~ 0.2280385	0.195573
5	0.2280385 ~ 0.3092675	0.260504
6	0.3092675 ~ 0.4440795	0.358031
7	0.4440795 ~ 1.0000000	0.530128

15. (Withdrawn) The method as recited in claim 12, wherein the quantization table further includes a table for a horizontal edge histogram bin representing the number of horizontal edges in the sub-image, which is expressed as:

Index	Range	Representative value
0	0.0000000 ~ 0.0411000	0.012266
1	0.0411000 ~ 0.0979065	0.069934
2	0.0979065 ~ 0.1540930	0.125879
3	0.1540930 ~ 0.2128515	0.182307
4	0.2128515 ~ 0.2789795	0.243396
5	0.2789795 ~ 0.3631455	0.314563
6	0.3631455 ~ 0.4880235	0.411728
7	0.4880235 ~ 1.0000000	0.564319

16. (Withdrawn) The method as recited in claim 12, wherein the quantization table further includes a table for a 45 degree edge histogram bin representing the number of 45 degree edges in the sub-image, which is expressed as:

Index	Range	Representative value
0	0.0000000 ~ 0.0150225	0.004193
1	0.0150255 ~ 0.0363560	0.025852
2	0.0363560 ~ 0.0576895	0.046860
3	0.0576895 ~ 0.0809025	0.068519
4	0.0809025 ~ 0.1083880	0.093286
5	0.1083880 ~ 0.1424975	0.123490
6	0.1424975 ~ 0.1952325	0.161505
7	0.1952325 ~ 1.0000000	0.228960

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17. (Withdrawn) The method as recited in claim 12, wherein the quantization table further includes a table for a 135 degree edge histogram bin representing the number of 135 degree edges in the sub-image, which is expressed as:

Index	Range	Representative value
0	0.0000000 ~ 0.0150490	0.004174
1	0.0150490 ~ 0.0360780	0.025924
2	0.0360780 ~ 0.0566975	0.046232
3	0.0566975 ~ 0.0784090	0.067163
4	0.0784090 ~ 0.1025230	0.089655
5	0.1025230 ~ 0.1336475	0.115391
6	0.1336475 ~ 0.1848245	0.151904
7	0.1848245 ~ 1.0000000	0.217745

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18. (Withdrawn) The method as recited in claim 12, wherein the quantization table further includes a table for a non-directional edge histogram bin representing the number of non-directional edges, which is expressed as:

Index	Range	Representative value
0	0.0000000 ~ 0.0292225	0.006778
1	0.0292225 ~ 0.0801585	0.051667
2	0.0801585 ~ 0.1374535	0.108650
3	0.1374535 ~ 0.1952415	0.166257
4	0.1952415 ~ 0.2549585	0.224226
5	0.2549585 ~ 0.3210330	0.285691
6	0.3210330 ~ 0.4036735	0.356375
7	0.4036735 ~ 1.0000000	0.450972

19. (Withdrawn) The method as recited in claim 7, wherein semantics of said each edge histogram bin of BinCounts is defined as:

Edge histogram bin	Semantics
BinCounts[0]	Vertical edges in sub-image (0,0)
BinCounts[1]	Horizontal edges in sub-image (0,0)
BinCounts[2]	45 degree edges in sub-image (0,0)
BinCounts[3]	135 degree edges in sub-image (0,0)
BinCounts[4]	Non-directional edges in sub-image (0,0)
BinCounts[5]	Vertical edges in sub-image (0,1)
. .	. .
BinCounts[74]	Non-directional edges in sub-image (3,2)
BinCounts[75]	Vertical edges in sub-image (3,3)
BinCounts[76]	Horizontal edges in sub-image (3,3)
BinCounts[77]	45 degree edges in sub-image (3,3)
BinCounts[78]	135 degree edges in sub-image (3,3)
BinCounts[79]	Non-directional edges in sub-image (3,3)

20. (Withdrawn) The method as recited in claim 1, further comprising step f) calculating a variation value of the video sequence and storing the variation value in the database, wherein the variation value includes a variance of the edge histograms of each image frames.

21. (Original) A method for retrieving a corresponding video sequence having a set of image frames of the digital video data in response to a query video sequence based on a database, the method comprising the steps of:

a) calculating L number of representative edge histograms of the query video sequence as an image descriptor for the query

video sequence, wherein each representative edge histogram represents a representative spatial distribution of 5 number of reference edges in sub-images of image frames in the query video sequence, wherein the reference edges includes 4 number of directional edges and a non-directional edge;

b) extracting a plurality of image descriptors for video sequences based on digital video data information from the database, wherein each image descriptor for said each video sequence includes L number of representative edge histogram bins for said each video sequence;

c) comparing the image descriptor for the query video sequence to said each image descriptor for each video sequences to generate a comparison result; and

d) retrieving at least one video sequence similar to the query video sequence based on the comparison results.

22. (Original) The method as recited in claim 21, wherein said each edge histogram has 5 number of edge histogram bins corresponding to the reference edges.

23. (Original) The method as recited in claim 21, wherein the directional edges include a vertical edge, a horizontal edge, a 45 degree edge, a 135 degree edge and the non-directional edge represents an edge of undesignated direction except for the 4 directional edges.

24. (Original) The method as recited in claim 21, wherein the step a) includes steps of:

a1) partitioning each image frame of query video sequence into L number of sub images, wherein each sub-image is further partitioned into S x T number of image-blocks, L, S and T being positive integers;

a2) assigning one of 5 number of reference edges to each image-block to thereby generate L number of edge histograms for each image frame, wherein the edge histograms include the M edge histogram bins and the reference edges include 4 number of directional edges and a non-directional edge;

a3) normalizing the edge histogram bins contained in each edge histogram by S x T to thereby generate M number of normalized edge histogram bins for said each image frame;

a4) calculating M representative edge histogram bins of said query video sequence in order to generate L number of representative edge histograms of each video sequence based on the normalized edge histogram bins of said each image frames

25. (Original) The method as recited in claim 23, wherein the step a2) includes the steps of:

a2-1) assigning one of the reference edges to each image block; and

a2-2) counting the number of each reference edge included in each sub-image to generate the L number of the edge histograms for the query video sequence.

26. (Original) The method as recited in claim 25, wherein the step a2-1) includes the steps of:

a2-11) dividing each image-block into 2 × 2 sub-blocks;

a2-12) assigning a corresponding filter coefficient to each sub-block;

a2-13) calculating a set of 5 edge magnitudes corresponding to five edges for each image-block by using the filter coefficient; and

a2-14) expressing the image-block as an edge having a maximum edge magnitude by comparing the calculated edge magnitudes each other.

27. (Original) The method as recited in claim 26, wherein the 5 edge magnitude are obtained by using 5 number of equations, which are expressed as:

$$m_v(i,j) = \left| \sum_{k=0}^{3} a_k(i,j) \ f_v(k) \right| ;$$

$$m_h(i,j) = \left| \sum_{k=0}^{3} a_k(i,j) \ f_h(k) \right| ;$$

$$m_{d!45}(i,j) = \left| \sum_{k=0}^{3} a_k(i,j) \# f_{d!45}(k) \right| ;$$

$$m_{d!135}(i,j) = \left| \sum_{k=0}^{3} a_k(i,j) \# f_{d!135}(k) \right|; \text{ and}$$

$$m_{nd}(i,j) = \left| \mathop{!}_{k=0}^{3} a_k(i,j)\ f_{nd}(k) \right|,$$ where $m_v(i,j)$, $m_h(i,j)$, $m_{d!45}(i,j)$, $m_{d!135}(i,j)$ and $m_{nd}(i,j)$, respectively, denote vertical, horizontal, 45 degree, 135 degree and non-directional edge magnitudes for a $(i,j)^{th}$ image-block; $a_k(i,j)$ denotes an average gray level for a sub-block assigned k in the $(i,j)^{th}$ image-block and $f_v(k)$, $f_h(k)$, $f_{d!45}(k)$, $f_{d!135}(k)$ and $f_{nd}(k)$ denote, respectively, filter coefficients for the vertical, horizontal, 45 degree, 135 degree and non-directional edges where k represents a number assigned to each sub-block.

28. (Original) The method as recited in claim 26, wherein the maximum edge magnitude is greater than a predetermined threshold value, otherwise the image block is considered to contain no edge.

29. (Original) The method as recited in claim 21, wherein the image descriptors for the query and target video sequence further include a global edge histogram and R number of the semi-global histograms based on the Lx5 number of representative edge histogram bins, respectively, R being a positive integer.

30. (Original) The method as recited in claim 29, wherein the global edge histogram represents an edge distribution in a whole space of the query and target video sequences and each semi-global edge histogram represents an edge distribution in a corresponding set of sub-images of the query and target video sequences.

31. (Original) The method as recited in claim 29, wherein said N and R are 4 and 13, respectively.

32. (Original) The method as recited in claim 31, wherein each of the 13 semi-global edge histograms is generated for each

of 13 sets of 4 sub-images, wherein the 13 sets include: four sets of 4 sub-images, each set including 4 sub-images in each of first to fourth columns of the image in vertical direction; four sets of 4 sub-images, each set including 4 sub-images in each of first to fourth rows in horizontal direction; four sets of 4 sub-images, each set including a corresponding sub-image and 3 sub-images neighboring the corresponding sub-image, wherein the corresponding sub-image is respectively located on the left-top, on the right-top, on the left-bottom and on the right-bottom of the image; and a set including 4 sub-images around the center of the image.

33. (Original) The method as recited in claim 21, wherein the step b) includes the steps of:

b1) retrieving L x 5 number of quantization index values for each of the target video sequence;

b2) converting each of the L x 5 number of quantization index values into L x 5 number of representative edge histogram bins for said each target vides sequence by using 5 number of non-linear inverse quantization tables; and

b3) generating L number of representative edge histograms based on the L x 5 number of normalized edge histogram bins.

34. (Original) The method as recited in claim 33, wherein the step b) further includes the step of: b4) further generating a global edge histogram and R number of semi-global histograms for each of the target video sequence based on the L x 5 number of representative edge histogram bins.

35. (Original) The method as recited in claim 21, wherein the step b) includes the steps of:

b1) retrieving L x 5 number of quantization index values for each of the target vides sequence;

b2) converting each of the L x 5 number of quantization index values into L x 5 number of representative edge histogram bins for said each target video sequence by normalizing the L x 5 number of quantization index values; and

b3) generating L number of representative histograms based on the L x 5 number of representative edge histogram bins.

36. (Original) The method as recited in claim 35, wherein the step b) further includes the step of: b4) further generating a global edge histogram and R number of semi-global histograms for each of the target images based on the L x 5 number of normalized edge histogram bins.

37. (Original) The method as recited in claim 34, wherein the step c) includes the step of:

estimating a distance between the query video sequence and said each target video sequence by equation as:

$$Distance(A,B) = \sum_{i=0}^{79} \left| Local\_A[i] - Local\_B[i] \right| + 5 \sum_{i=0}^{4} \left| Global\_A[i] - Global\_B[i] \right| + \sum_{i=0}^{64} \left| Semi\_Global\_A[i] - Semi\_Global\_B[i] \right|$$

where Local_A[i] and Local_B[i] denote, respectively, the edge histogram bins of BinCount[i] of the query video sequence A and the target video sequence B; Global_A[] and Global_B[] denote, respectively, the edge histogram bins for the global edge histograms of the query image A and the target image B; and Semi_Global_A[] and Semi_Global_B[] denote, respectively, the histogram bin values for the semi-global edge histogram bins of the query video sequence A and the target video sequence B.

38. (Original) The method as recited in claim 36, wherein the step c) includes the step of:

estimating a distance between the query video sequence and said each target video sequence by an equation as:

$$Distance(A,B) = \sum_{i=0}^{79} \left| Local\_A[i] - Local\_B[i] \right| + 5 \sum_{i=0}^{4} \left| Global\_A[i] - Global\_B[i] \right| + \sum_{i=0}^{64} \left| Semi\_Global\_A[i] - Semi\_Global\_B[i] \right|$$

where Local_A[i] and Local_B[i] denote, respectively, the edge histogram bins of BinCount[i] of the query video seqence A and the target video sequence B; Global_A[] and Global_B[] denote, respectively, the edge histogram bins for the global edge histograms of the query video sequence A and the target video sequence B; and Semi_Global_A[] and Semi_Global_B[] denote, respectively, the histogram bin values for the semi-global edge histogram bins of the query video sequence A and the target video sequence B.

39. (Withdrawn) A method for extracting an image description for video sequence, each having a plurality of image frames of the digital video data, the method comprising the steps of:

a) selecting a one of the image frames as a target image frame;

b) calculating Lx5 number of normalized edge histogram bins to generate L number of edge histograms of the target image, wherein said each edge histogram has 5 number of normalized edge histogram bins and represents a spatial distribution of 5 number of reference edges in a sub-image and L is a positive integer, wherein the reference edges include 4 number of directional edges and a non-directional edge;

c) selecting a next image frame as a target image;

d) repeating steps b) and c) until L number of edge histograms of all image frames are calculated;

e) calculating a representative edge histogram having LX5 number of normalized edge histogram bins for the video sequence based on the L number of edge histograms of each image frame;

f) non-linearly quantizing the Lx5 number of normalized edge histogram bins of the representative edge histograms to generate Lx5 number of quantization index values as the image description for the video sequence; and

g) storing the Lx5 number of quantization index values to the database.

40. (Withdrawn) The method as recited in claim 39, wherein each quantization index value is represented by 3 bits.

41. (Withdrawn) The method as recited in claim 39, wherein the directional edges include a vertical edge, a horizontal edge, a 45 degree edge, a 135 degree edge and the non-directional edge represents an edge of undesignated direction except for the 4 directional edges.